



Agriculture Diversification in India

KEYWORDS

Agriculture diversification, High value agriculture and Simpson index

PANKAJ KUMAR

Research Scholar, Department of Mathematics & Statistics, Jai Narain Vyas University Jodhpur

ABSTRACT Various developing countries like India are shifting from traditional subsistence agriculture to commercial agriculture. Agriculture diversification in India play a vital role in diversifying and commercializing agriculture, adding value to agricultural produce, generate employment, enhance income of farmers, and create surplus for export of processed products. The result shows that consumption patterns are changing towards high value agricultural commodities from traditional agriculture and this is driving the process of agricultural diversification in India. The share of high value agriculture is increasing in the total value of agricultural output and exports. These commodities are the potential sources of future income. There is a need to suitable integrate production and marketing of high value commodities through appropriate institutions. Market reform in institutions through required legal changes would go a way in boosting agricultural growth and promoting exports.

Introduction

Agricultural sector is the backbone of Indian economy. The structure of the Indian economy has achieved a remarkable change after independence. It has been transformed from traditional agriculture-based economy to high value agriculture. With the advent of the green revolution, India has transformed itself from a country of shortages to a land of surpluses. With the rapid growth of the economy, a shift is also being seen in the consumption pattern, from cereals to more varied and nutritious diet of fruit and vegetables, milk, fish, meat and poultry products. This has resulted in the development of diversification of Indian agriculture.

Many developing countries like India are moving from traditional subsistence agriculture to commercial agriculture. India has tremendous potential to unleash large scale process based farm activities to exploit the emerging global business opportunities. If agriculture could be diversified and the agri-business industry developed, it would boost rural incomes and have a major impact on employment and equitable income growth throughout the economy. Agriculture diversification can, therefore, play a vital role in diversifying and commercializing agriculture, adding value to agricultural produce, generate employment, enhance income of farmers, and create surplus for export of processed products.

Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop diversification also takes place due to governmental policies and thrust on some crops over a given time.

Agriculture diversification in favour of more competitive and high value commodities is considered an important strategy to overcome many of these emerging challenges. If carried out appropriately, diversification can be used as a tool to augment farm income generate employment, alleviate poverty and conservation resources [Von Braun, 1995; Pingali and Rosegrant, 1995 and Ryan and Spencer, 2001]

The emerging trends of agriculture diversification and the

constraints it faces would help in making appropriate policies regarding institutional arrangements and creation of suitable infrastructure, which could benefit a large mass small and marginal farmer. The main objectives of the present paper are;

- * To examine the emerging trends, nature and speed of agricultural diversification in India.
- * To assess the implications of agricultural diversification on food security, employment and export.

Rest of this paper is organized as follows: The next section discusses the methodological framework and data sources. This is followed by emerging trends of agriculture diversification in India and Implications of agriculture diversification. Conclusions and policy implications are made in the final section.

Methodology and Data Sources

The level of crop diversification effects the extent of economic development in the rural sector of India. It varies among regions because of varied agro-climatic conditions and resource endowment of the farms. The introduction of new-seed-fertiliser technology has not only led to intensification of farming but also results in large scale diversification of crop farming and the benefits gradually accrued to the whole farming community (De, 2000).

There are few methods, which explain the diversification of the commodities or activities in a given time and space by a single quantitative indicator. These ones include: (I) Index of maximum proportion, (II) Herfindal Index, (III) Simpson Index, (IV) Ogive Index, (V) Entropy Index, (VI) Modified Entropy Index and (VII) Composite Entropy Index [Shiyani and Pandva, 1998; Kelley Ryan and Patel, 1995; Ramesh Chand, 1996].

Each method has some superiority and/or limitation over the other. The Simpson Index approach used in this study for considering our objectives of assessing the extent of diversity in crop sector, livestock, forestry and fisheries activity. This index provides a clear dispersion of commodities in a geographical region. It ranges between 0 and 1. If there exists complete specialization, the value of index moves towards zero. The index is easy to compute and in-

terpret.

The Simpson index is given by;

$$SID = 1 - \sum P_i^2$$

Where, SID → Simpson index of diversification

Pi → Proportionate area (or value) of ^tth crop/live stock/ fisheries activity in the gross cropped area (or total value of output)

The nature and patterns of diversification in India were examined by looking into temporal changes in area of different crops. It was also examined for different activities of agriculture sector i.e. value of crops, livestock, forestry and fisheries activities. To estimate the speed of diversification in favour of high value commodities, compound annual growth rate (CAGR) of area, production and yield of different crop were computed. In this study, diversification is measured at three Triennium Ending i.e. TE 1990-91, TE 1999-2000 and 2006-07. For analytical convenience this period has been divided into two sub periods, namely, 1990/91 to 1999/2000 (first sub-period) and 2000/01 to 2006/07 (second sub-period).

A widely accepted exponential model, $y = a b^t e^u$, has been fitted to the time series data for estimating growth rates. The logarithmic form of this function is given by;

$$\ln(y) = \ln(a) + t \ln(b) + u$$

Where,

- y → Dependent variable whose growth rate is to be estimated.
- t → Independent variable (Time)
- u → Disturbance or error term.

a and b are the parameters to be estimated from sample observations. The regression coefficient b is estimated by ordinary least squares (OLS) technique.

The Compound Average Growth Rate (CAGR) in % term is estimated as:

$$CAGR = \{ \text{antilog}(b) - 1 \} * 100$$

Data Sources: -

This Paper is based on the secondary data sources. e.g the values for various agricultural/ allied agriculture commodities taken from the National Accounts Statistics prepared by the Central Statistical Organization (CSO), Ministry of Statistics and Program Implementation, Government of India. The data on crop areas, production and yield have taken from the publications of the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. For analysis of per capita consumption patterns of food items come from the various round of National Sample Survey Organization (NSSO). The data on some other variables are collected from Directorate General of Commercial Intelligence & Statistics, Government of India (GOI) and Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India (GOI).

Emerging Trends, Nature and Speed of Agricultural Diversification

Diversification of agriculture in India is gradually transferred in favour of non-food crops to augment incomes rather than a coping strategy to manage risk and uncertainty. The Simpson index of diversification and share of food crops and non-food crops in India at three triennium ending i.e. TE 1990-91, TE 1999-2000 and 2006-07 are presented in

Table 1.1. The results show that crop sector is gradually diversifying in India. The value of Simpson index of diversification (SID) increased from 0.43 in TE 1990-91 to 0.47 in TE 2006-07. The trends also showed that the non-food crop have gradually replaced food

Table 1.1: SID and Share of Food Crops and Non-Food Crops in India

Period	Simpson Index of Crop Diversity	Share of Food Crops and Non-Food Crops	
		Food Crops (Area)	Non-Food Crops (Area)
TE 1990-91	0.43	67.90	32.10
TE 1999-2000	0.45	66.31	33.69
TE 2006-07	0.47	63.79	36.21

Sources: Directorate of Economics and Statistics (DES), Ministry of Agriculture.

Crops :

The share of food crops in India at three triennium ending i.e. TE 1990-91, TE 1999-2000 and 2006-07 are decreased i. e. 67.90, 66.31 and 63.79 per cent respectively, while the share of non-food crops in India at TE 1990-91, TE 1999-2000 and 2006-07 are gradually increased i.e. 32.10, 33.69 and 36.21 per cent respectively. It means that non-food crops like oilseeds, fruits, vegetables, spices and sugarcane have mainly substituted coarse cereals while in search for higher incomes. Figure (a) presents the index number of area under foodgrains, non-foodgrains and all crops for the study period i.e. 1990-91 to 2006-07. The figure showed that the gap between foodgrains and non-foodgrains are gradually increased. This shows that India is gradually diversifying in favour of high value commodities. i.e non-food crops.

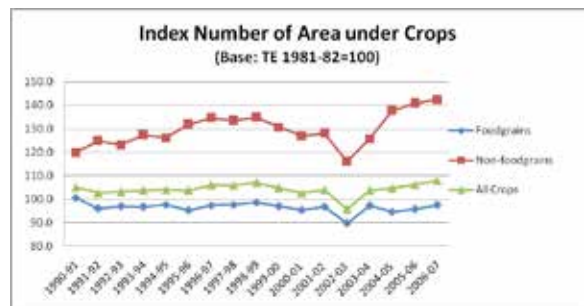


Figure (a)

To examine the nature and speed of agricultural diversification, production performance and area expansion of different commodities was assessed. The compound average growth rates (CAGR) of area, production and yield in India with respect of major commodity for the two sub-periods: 1990/91 - 1999/2000 and 2000/01 - 2006/07 as also for the complete period are presented in Table 1.2. The results showed that production performance of non-food commodities was superior to the food commodities. Among foodgrain group, cereals performed better than coarse cereals. Cereals sector was specializing in favour of rice and wheat. It was because of overriding concern for food self sufficiency in India. Rice and wheat replaced sorghum, millets and barley. The performance of pulses was better in second period as comparison to first period.

Table 1.2: CAGR of Area, Production and Yield of Principal Crops

Crop	1990-91 to 1999-2000			2000-01 to 2006-07		
	Area	Production	Yield	Area	Production	Yield
Rice	0.68	2.02	1.34	0.14	1.87	2.00
Wheat	1.72	3.57	1.83	1.29	1.36	0.08
Coarse Cereals	-2.12	-0.02	1.82	-0.41	3.25	4.25
Total Cereals	0.04	-0.02	1.59	0.16	1.95	3.10
Total Pulses	-0.60	0.59	0.93	1.91	3.42	1.65
Total Food grains	-0.07	2.02	1.52	0.48	2.09	2.82
Sugarcane	-0.07	2.73	1.05	1.89	2.20	0.30
Total Oilseeds	-0.86	1.63	1.15	2.71	6.69	4.91
Cotton	2.71	2.29	-0.41	1.45	17.48	15.79
Jute & Mesta	1.81	1.81	0.87	-1.75	0.04	2.51
Total Fibres	2.45	2.21	-0.27	1.09	15.23	14.14
Potato	3.84	5.44	1.54	3.05	-0.50	-3.44
Tobacco	1.56	1.00	-0.55	3.71	3.54	-0.17
Non Foodgrains	1.18	2.69	1.09	2.46	5.09	3.87
All Principal Crops	0.27	2.29	1.33	1.06	3.17	3.88

Sources: DES, Ministry of Agriculture, Government of India (GOI)

Indian farm output has been diversifying away from cereals and towards high value crop after 1990s. The performance of high-value products, including fruits and vegetables, sugar and fiber crops, sugarcane, cotton, and tobacco, has significantly better than foodgrains crop in specially in second period of the reference. The results indicates that the speed of diversification is higher in second sub period as compared to first sub period of the study.

Diversification of agriculture in India is gradually transferred in favour of commercial agriculture i.e. high value crop/livestock/ fishery activities to enhance the incomes of farmers and reduce the poverty. The share of individual sector in gross value of agricultural output and Simpson diversification index (SID) in India at three triennium ending i.e. TE 1990-91, TE 1999-2000 and 2006-07 are presented in Table 1.3. The table shows that there are four core sub sector of agriculture i. e. crop, livestock, fisheries and forestry. Crop sub-sector is the principal sources of generating income in agriculture followed by livestock, forestry and fisheries sub-sector. The results indicate that the share of crop sector in agricultural gross domestic product marginally declined during the study period i.e. form 73.65 in TE 1990-91 to 70.56 in TE 2006-07. On the other side the share of livestock, forestry and fisheries sub-sector has marginal increased in the same period. The results also indicate that the crop sector is gradually diversifying towards livestock, forestry and fisheries sub-sector. The value of Simpson index of diversification (SID) increased from 0.46 in TE 1990-91 to 0.50 in TE 2006-07. This showed that the crop sub sector have gradually shifts towards livestock, forestry and fisheries sub-sector.

Table 1.3: Share of Individual Sector in Gross Value of Agricultural Output in India at Constant Prices (per cent)

Period	Crops Sector	Livestock	Forestry	Fishing	Simpson Index
TE 1990-91	73.65	23.09	1.91	1.35	0.46
TE 1999-2000	71.11	24.28	2.36	2.25	0.49
TE 2006-07	70.56	25.24	2.02	2.18	0.50

Sources: CSO

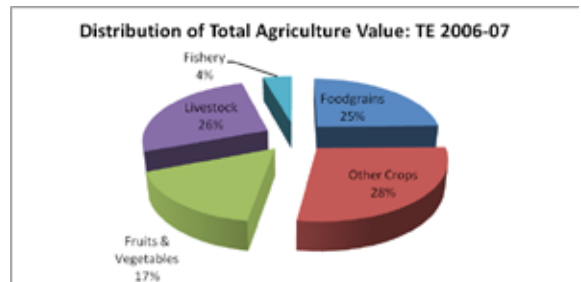


Figure (b)

Figure (b) shows the recent conditions of distribution of total agriculture value in India. The potential for gains from food grain production are now limited, although more than 60 percent of gross cropped area is under cereals and pulses; their share of the value of total agricultural output is now less than 25 percent (TE 2006-07). High value commodities, particularly horticulture, livestock, and marine products, are highly expenditure elastic compared with grains. Given rising incomes and higher expenditure elasticity for these commodities, future growth is likely to come from the high value sector (Gulati and Ganguly, 2008). The share of high value commodities, including horticulture, livestock, and fisheries, in the total value of agricultural output has already increased from 40.2 percent in TE 1990-91 to 47.5 percent in TE 2006-07.

Implications of Agricultural Diversification

There are several benefits of agricultural diversification in India. These are shifting consumption pattern, improve food security, increase income, generating employment opportunity, reduce poverty, improving productivity, promoting exports etc. In this section the present study have assessed implication of diversification on following aspect;

- Improving Food Security
- Generating Employment Opportunities
- Promoting Export

Food Security

Food security is the important aspect of agricultural diversification in the context of India. Increasing in production of foodgrains ia major challenge, when population and incomes are rising, and natural resources degrading. The shift of food crops to non-food crop portfolio may lead to food insecurity. The crop substitution was also taking place, which was diverting area in favour of high yielding cereals from low yielding inferior cereals.

The per capita consumption pattern of food items in India with respect rural and urban areas of various National Sample Survey Organisation (NSSO) rounds are present in Table 1.4. The production trends reveals that the per capita daily availability of foodgrains has increased during the

study period.

Item Group	1987/88	1993/94	1999/2000	2004/05	2005/06	2006/07
Rural						
Total cereals	41.92	68.9	108.75	101.77	107.68	116.44
Pulses	6.27	10.7	18.5	17.18	20.02	22.67
Milk & milk products	13.63	26.7	42.56	47.31	50.94	56.23
Edible oil	7.88	12.5	18.16	25.72	25.46	27.22
Egg, fish & meat	5.11	9.4	16.14	18.6	24.31	24.32
Vegetables	8.23	17.0	29.98	34.07	37.88	43.06
Fruits & nuts	2.57	4.9	8.36	10.42	11.75	12.47
sugar	4.51	8.6	11.57	13.25	14.83	14.04
Urban						
Total cereals	37.55	65.4	106.87	107.44	111.54	120.98
Pulses	8.44	13.9	24.25	22.51	25.57	30.06
Milk & milk products	23.84	44.9	74.17	83.3	84.94	97.49
Edible oil	13.23	20.1	26.81	36.37	35.02	37.52
Egg, fish & meat	8.85	15.5	26.78	28.47	32.28	34.2
Vegetables	13.12	25	43.9	46.84	49.73	56.87
Fruits & nuts	6.27	12.2	20.68	23.65	25.52	28.0
sugar	5.86	10.9	14	15.88	17.45	17.25

Sources: NSSO Survey records

Given sustained increases in per capita incomes of about 4 percent per year during the past two decades, consumption patterns in India are changing away from cereals to high-value agricultural products. The results showed that per capita consumption of cereals from 1993-94 to 2006-07 have marginal increased from Rs.70 to Rs.116 per month in rural areas and from Rs.65 to Rs.120 in urban areas. The consumption of fruits, vegetables, milk and milk product, meat and meat product, eggs, and fish have rapidly increased in urban areas as well as rural areas over the study period. Similar changes occurred in urban diets. These dramatic changes indicate a structural shift in Indian diets.

Employment

Employment generation in rural areas is the tuff task. Now is a question that, can agricultural diversification help in generate additional employment opportunities in rural areas? Some information was collated on average labour use in cereal, non-cereal and vegetables and presented in Table 1.5. This table showed that labour used for cultivation of vegetables is sustaintially higher than cereals. Area shift from cereals to vegetables would generate additional employment in rural areas. So we can say that high-value agricultural products have higher employment elasticity.

Cereals and Non-Cereals		Vegetables	
Crop	Labour Use	Crop	Labour Use
Rice	105	Potato	200
Wheat	55	Onion	125
Sorghum	55	Cabbage	110
Pearl Millet	50	Cauliflower	120
Cotton	100	Egg Plant	70
Sugarcane	190	Tomato	195

Source: Subramanian et al (2000) and GOI (2000)

Exports

International trade of India in high-value food products has expanded enormously over the last decades, fueled by changing consumer tastes and advances in production. The performance of agriculture and allied product exports in India are given in Table 1.6.

The results showed that share agricultural exports in India decline at 12.66 per cent in second sub period, as

against 18.56 per cent during first sub period. The share of foodgrains crops is very lower in agriculture exports i. e. around 12 per cent. A large share of agriculture export was contributed by diversification of crop and livestock sector. It was noted that diversification of agriculture commodities has promoted export of many non-traditional items. The progress of high value agriculture items during the

Agriculture and allied products	1990-91	1995-96	2000-01	2006-07	CAGR	
					First Period	Second Period
Cereals (Rice & Wheat)	8.19	24.26	12.27	12.32	28.36	11.87
Plantation Crops	21.97	13.14	10.90	6.86	13.63	4.63
Fruits and vegetables	14.50	13.04	15.44	12.94	16.42	10.24
Oil meals	10.11	11.54	7.49	9.59	12.62	20.69
Spices	3.89	3.90	5.93	5.50	25.47	10.63
Marine products	15.95	16.62	23.33	13.94	19.12	3.52
Meat and meat preparations	2.32	3.08	5.39	5.77	22.03	17.16
Fibres (Cotton)	14.05	1.00	0.81	10.64	-7.98	108.13
Tobacco	4.38	2.20	3.18	2.94	15.05	12.09
Sugar and molasses	0.62	2.49	1.85	5.68	-3.90	3.46
Others	4.02	8.73	13.41	13.81	33.59	17.69
Total	100.00	100.00	100.00	100.00	18.58	12.66

* First Period: 1990/91-1999/2000 and Second Period: 2000/01-2006/07 Sources: Reserve Bank of India (RBI)

Reference period was quit impressive. This implies that agriculture diversification can substantially contribute to export provided a congenial environment through infrastructure development and institutional innovation is created.

Conclusions

The overall analysis indicate that India is moving from traditional subsistence agriculture to high value agriculture. Agriculture diversification in India play a vital role in diversifying and commercializing agriculture, adding value to agricultural produce, generate employment, enhance income of farmers, and create surplus for export of processed products. The result shows that consumption patterns are changing towards high value agricultural commodities from traditional agriculture and this is driving the process of agricultural diversification in India.

Consumption patterns are changing towards high value agricultural commodities and this is driving the process of agricultural diversification in India. The share of high value agriculture is increasing in the total value of agricultural output and these commodities being highly expenditure elastic are the potential sources of future income. This de-

mand led phenomenon can help achieve many strides for the agricultural sector in India, provided policy can look beyond farming and better integrate production agriculture with other components of the agri-structure.

The present study also highlighted the implications of agriculture diversification on food security; generate employment and earnings from exports. The results showed that food security was not so adversely affected as a consequence of agricultural diversification. Similarly the high value crops have substantial potential for generating employment opportunities. Most of the high value crops are high labour requirement crops. The high value commodities have also witness good performance in the international trades. The structure of India's agricultural exports has been gradually changing in favour of high-value food products (horticultural and animal foods), international food safety and quality standards are becoming stringent. Their compliance will be a key to the growth of exports of high-value food products. Thus, appropriate quality testing and certification procedures will have to be put in place.

REFERENCE

- Birthal, P.S., P.K. Joshi and Ashok Gulati (2005), Vertical Coordination in High Value Commodities: Implications for Smallholders. Markets, Trade and Institutions Division Discussion Paper no. 85, International Food Policy Research Institute, Washington D.C. | Chand, Ramesh (1996), Diversification through high value crops in western Himalayan region: evidence from Himachal Pradesh. *Indian Journal of Agricultural Economics*, Vol. 41(4): 652-663. | Directorate of Economics and Statistics (DES), Ministry of Agriculture, Government of India (GOI), New Delhi | Government of India, (2008), National Accounts Statistics, Central Statistical Organization, Ministry of Statistics and Program Implementation, Government of India (GOI). | Gulati, Ashok and Kavery Ganguly (2008), Beyond Grain Security: Agriculture Tomorrow, The Business Standard, New Delhi. | Joshi, P.K., Gulati, A., Birthal, P.S., and Tiwari, L. (2005). Agriculture Diversification in South Asia: Patterns, Determinants, and Policy Implications. In S.C. Babu and A.Gulati (Eds.), *Economic Reforms and Food Security*. USA: The Haworth Press, Inc. | National Sample Survey Organization (various rounds), Household Consumer Expenditure in India, Ministry of Statistics and Programme Implementation, Government of India. | Pingali, P.L. and Rosegrant, M.W. (1995), Agricultural commercialization and diversification: processes and policies. *Food Policy*, 20(3): 644-651. | Rao C.H.H.(2000), "Declining Demand for Foodgrains in Rural India: Census and Implications", *Economic and Political Weekly*, January 22. | Ryan, J.G. and D.C. Spencer. (2001), Future Challenges and Opportunities for Agricultural R&D in the Semi-Arid Tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. | Von Braun, J. (1995), Agricultural commercialization: impacts on income and nutrition and implications for policy. *Food Policy*, Vol. 20 (3): 187-202. |